Housing an Extended Family in New Zealand

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Introduction

With its relatively large size and high standard of living, New Zealand is host to migrating communities from neighboring sub-tropical Pacific island states and dependencies. However, many Pacific Nations households, together with many Maori households in New Zealand, are struggling financially, so the housing decisions that they make are driven by rental costs, not cultural, functional or health requirements.

The cheapest housing available in New Zealand is typically more than 30 years old, the “standard” suburban or rural house being a two or three-bedroom detached bungalow. Such houses were originally intended for 4 or 5-person nuclear families but this is a household type that is now in the minority in New Zealand. It is increasing common for bungalows to be occupied by extended families or more than one family, in mulit-generational households with many times the population for which the houses were originally designed. The houses are being used differently, too. Household use patterns typically mean that a house is closed up during the day when everyone is at school or work, and intensively used in early mornings, evenings and weekends for washing and cooking. From a health perspective, this crowding situation is made critical by climatic and house construction/design factors, together with the production of a large amount of moisture inside, and inadequate heating. The climate in most parts of New Zealand is cool and humid, yet surprisingly the housing stock built prior to 1978 is un-insulated and poorly heated. Consequently, older New Zealand houses, which are mostly of light-weight timber construction, are cold and damp. Recent research at the Wellington School of Medicine and elsewhere shows that dampness and overcrowding are linked to serious and growing health problems in New Zealand. As well, various construction and design factors can play a significant part in creating a healthy and supportive environment, or not.

This paper reports on aspects of a participatory design project that forms part of the He Kainga Oranga/Housing and Health Research Programme led by Philippa Howden-Chapman at the Department of Public Health, Wellington, and involves collaboration between researchers at the Wellington School of Medicine, the School of Architecture at Victoria University of Wellington, members of the Tokelaun community in Porirua, and Housing New Zealand Corporation (for details, see elsewhere in this conference, and Howden-Chapman et. al. 2003).. The objective of the project is to apply the knowledge derived from recent health and housing research together with community and other stakeholders’ experience, in the design of an extended family house that is affordable, sustainable and culturally appropriate for large Maori or Pacific Nations households, and provide a domestic environment that is healthy.

The resulting house design makes use of standard products, materials, space and building elements but combines them in innovative ways. This paper reports on the ways in which this house differs from ‘standard’ social housing in New Zealand and concludes with the author’s observations about the lessons learned from this project, and implications for policy makers, politicians and designers.

Damp, cold and other problems for low-income extended-family households

The traditional way to remove damp in New Zealand houses is through openable windows. The literature leads us to the conclusion that 'natural' ventilation works if properly designed. Thus, according to the New Zealand Building Code, manually operated windows are an acceptable solution to the ventilation requirements for domestic dwellings (Building Industry Authority 1998). Although it is common nowadays for electrically-powered exhaust fans to be provided in kitchens and bathrooms in 'better' houses, industry practices together with national and international Standards indicate wide-spread scientific and professional acceptance that natural and passive ventilation can be effective in keeping a house environment dry and healthy (eg. Standards New Zealand 1990, Bassett 1998). In short, we believe that the code-complying openable windows are functionally sufficient. By extension, we believe that people should be able to keep a house properly ventilated by using windows.

However, there is evidence that code compliance is no guarantee of a healthy house. In a large survey, a third of New Zealand households reported visible mould in their houses (Howden-Chapman et al 2002). The existence of damp and mould in a house indicates conditions that are highly conducive to the spread of communicable disease. The production and concentration of moisture in a house increases with household population, the risk factors increasing exponentially with increases in the household size. It has been estimated that more than ten percent of New Zealanders live in crowded conditions and that roughly one third of the houses in the country are cold and damp (Howden-Chapman 2004). If one third of New Zealand's houses are damp and cold, what makes the difference between them and the roughly two thirds that are warm and dry? Certainly, to achieve warm dry indoor conditions in New Zealand's cold damp climate requires a combination of insulation, heating and ventilation, but is this only a hardware problem?

A home is a system comprising the physical house and the people who use it. A failure in the system (e.g. sickness among occupants) may result from various generic 'natural causes' such as damp, various human behaviours such as keeping windows closed, or a combination of these generic causes (Porteous, 1992). For a house to function properly, each part of the system must perform to an appropriate level – the house and its people. Here is the crux of the problem. For example, if a house design *requires* a certain level of human intervention such as opening windows for ventilation, and the windows remain closed, the system will degrade and may fail. Or, if the occupants of a house reasonably *require* something of a house that it cannot provide, such as accommodate a group of extended-stay visitors, the system also degrades and may fail. Failures can and do happen when narrowly framed assumptions about householders' behaviours are made by designers and other providers, including the notion that a building that meets code requirements must *per se* be suitable for any household.

The author recently investigated the supposition that natural ventilation is sufficient to maintain dry indoor conditions, by conducting physical and behavioral experiments in an un-insulated moldy 1963 house in Wellington over a six-month period including winter (Gray, 2004). It was found that a three-person household could achieve tolerably dry conditions, but only by managing a tiresome regime of counter-intuitive and abnormal behaviours. This experience adds weight to anecdotal evidence, together with data from surveys cited earlier, which suggests that is impractical and unreasonable to expect a large household, and particularly an overcrowded household, to manage ventilation in a comparable code-compliant house in New Zealand's climate. If this is a correct reading of the situation, we need a new paradigm for the design and delivery of social housing.

Causal links between housing and health

The physical attributes of a house comprise its materials, components and arrangement. These attributes combine in varying ways to provide the physical environment of a house. The behaviors and activities of householders are the things that people do in a house, and their use of it. When we say that health and the house/environment are related, we imply causal linkages between various attributes of the house (mostly interior), the activity or behavior of householders, and different types of illness. This section of the paper lists the physical attributes and behaviors that we know, or strongly suspect, are causal links to the health and well-being of occupants. They are presented in the form of a matrix to show that the various attributes of a house which can cause sickness are parts of a complex system in which changes to one part can alter the performance of the whole. Furthermore, not all parts equally or as directly influence the health outcome, while some support and others conflict with desirable outcomes. From this we can see the complexity of the challenge faced by the designers and providers of a house that is to safely and economically accommodate an extended family

Table 1: Probable causal links between housing, and health

	(dis)comfort	security	privacy	cultural use	population	management	activity	mold	ventilation	health	Well-being	windows	plan layout	damp	cold	insulation	space	Materials
(dis)comfort																		
security																		
privacy																		
cultural use	O	O	O															
population			O															
management					O													
activity		O	O		O													
mold					O													
ventilation	O	O			O	O												
health				O	O			O										
well-being	O		O	O			O											
windows		O		O					O									
plan layout	O		O	O							O							
damp					O	O		O	O	O								
cold	O					O			O	O	O							
insulation								O				O						
space	O		O	O	O						O		O					
materials			O					O		O				O	O	O		

Specific design qualities needed in a house for an extended family

This following list of design attributes are additional to, or are significantly different to, a modal house design of comparable size, but make the house suitable and safe for an extended family household in a New Zealand climate. These features are intended to solve problems of building-related sickness and culturally inappropriate design. Added costs for each category are indicated in square brackets, expressed as a percentage of the cost of a code-compliant modal house. Thus, if a 200m2 modal house costs $270,000, a feature that costs an added $13,500 would add 5%.

Insulation [5% added cost]

- Roof insulation in excess of code requirements [110mm instead of 75mm batts plus Aircell blanket]. The code requirement for roof insulation varies through the country but in each climatic zone the insulation requirement is expressed as a *minimum* standard. In densely-populated households wit high levels of moisture production inside, insulation to code requirements will usually *not* be sufficient to maintain indoor night-time temperatures high enough to combat condensation, (hence mould growth) unless significant amounts of heating are provided. Low income households tend to avoid or minimize heating to reduce costs, or worse, use cheaper gas heating appliances without external flues which themselves generate large amounts of water from combustion.
- Wall insulation in excess of code requirements [94mm instead of 75mm batts]. Like the roof, adequate (above code) wall insulation is needed to combat condensation problems. Walls are also an important source of radiant heat loss, making people nearby feel cold even if the indoor air temperature is reasonable.
- Under-floor insulation [200mm EPS and rib structure]. The standard particle-board flooring on timber framing is substituted by a concrete floor slab for solar heat storage, and as a robust surface (reasons that are further explained later in the paper). The concrete slab is insulated from the cold ground with recycled EPS (expanded polystyrene) to reduce heat loss through the floor by conduction and radiation, and to retain heat.
- Double glazing to selected windows [double glazing units instead of single glazing]. Standard windows are a major cause of cold conditions in minimally-heated NZ houses. As well as contributing to condensation problems, cold conditions can be a serious risk for old and very young people. BRANZ now recommend double glazing in most North Island areas, and triple glazing in parts of the South Island. The design incorporates double glazing to the living room where most people congregate at night-time, and to south-facing bedroom windows. North and west-facing double glazed windows to living areas also assist with heating the house.
- Basic level of insulated lining in the garage, [Aircell blanket lining in place of no lining]. Pacific nation communities are accustomed to occasionally using garages for a range of people/culturally based functions in addition to storing vehicles and belongings. Most garages are uninsulated and unlined, and if use by people at night, condensation and cold will be a serous problems. The garage is lined with an insulation material resembling bubble-wrap that provides a modest R value, reduces radiant heat losses which improves comfort, is reasonable robust, and has an appearance that is reasonably acceptable for temporary and short-term gatherings.

Ventilation [3.1% added cost]

- Passive vents in windows [37 operable vents in sashes]. In very cold or windy conditions, or during the working day when a house is left unoccupied, windows will normally be closed, and stop performing a ventilating function. Contemporary standard window frames are tight-fitting to prevent drafts that commonly occurred in earlier types of timber windows, and they normally lack the means for passive ventilation. The proposed house has passive vents in the frames to provide a trickle of ventilation at all times.

- Passive rotary (wind-powered) vents [four vents over kitchen, two bathrooms and dormitory] The modal house has some form of electrically-powered mechanical ventilation exhaust facility in the bathrooms and kitchen. In social housing funded by HNZC, designers are discouraged from specifying electrically operated exhaust vents and range hoods because of the high maintenance required, and added operating costs. In the proposed house, passive rotary vents are specified for bathrooms and kitchen where the most moisture is generated in a short time. They work by mechanically extracting air at ceiling level, assisted by the stack effect due to differences in temperature and hence air density inside and outside. An added advantage of passive vents is that they work without intervention by the occupants.
- Added openable windows [about 6m2 of added sash windows] . Two bedrooms, a dormitory bedroom, the laundry, bathrooms and the kitchen are provided with additional windows (beyond the minimum to meet code requirements), located to promote cross-ventilation. This enables the occupants to take direct, quick and intuitive action by opening the window if it is obvious that there is a lot of moisture inside. Many Pacific Nations people also have a cultural preference for air movement reaching the indoors through window openings.
- Separation of moisture-producing functions/spaces from habitable rooms [extra distance for pipe runs, separate laundry, add 1.6%]. Planning economies are normally made (in terms of minimizing plumbing costs, and minimising circulation space) by locating bathrooms, kitchen and laundry (the “wet” areas) together. In a conventional house the “wet” areas of the house are in close proximity to the habitable rooms, usually lying between the living and bedroom zones. Instead, the proposed house has the kitchen, bathrooms and laundry separate from each other and distanced from the habitable living and sleeping spaces in the house. This has been done to maximize ventilation and minimize the migration of moisture to habitable spaces.

Heating and daylighting [4.1% added cost]

- Passive solar design for main living quarters [add for cost of concrete finish]. North, east and west-facing windows are above average in size and number to take advantage of sunny but cold/windy atmospheric conditions for heat gain, especially in winter. Double glazing ensures that the heat can be captured inside (unless released by opening windows and doors for cooling/ventilation). Concrete floors heat up and retain the heat provided they are not covered by carpet. To make concrete visually and functionally acceptable as a finish it is necessary to specify a more costly surface treatment process.
- Added fixed glazing for light [about 7m2 of added fixed windows] Many Pacific Nations people have a cultural preference for large amounts of daylight reaching the indoors.
- Passive solar and daylighting design for the garage [about 20m2 of clear cladding plus added height]. As discussed earlier, the garage is sometimes called on to function as a shelter when the household is visited by a large number of people. The north-facing wall of the garage is designed to gain heat and daylight through a polypropylene sheeting product.
- Sunny outdoor terraces. Outdoor areas are designed for shelter and solar gain by “stretching” the house to provide for morning and afternoon terraces, sheltered from prevailing winds and adjacent to the kitchen and dining space. These terraces provide room for groups of people, outdoor eating, and children’s play space. This strategy results in added cost due to some increase in wall surface area.
- Heat pump. Heat pumps are more costly to buy than the typical convection or radiant heaters, and require regular maintenance (neither of which the landlord likes) but because they are significantly more efficient in their use of energy, the operating costs are reduced, to the benefit of the tenant. An added advantage is

that the fan in a heat pump unit mixes the air in the space, smoothing out the temperature difference between air near the floor and air near the ceiling.

- Bathroom heaters Because of HNZC resistance to the use of electrically powered exhaust fan systems for ventilation of wet areas, the bathrooms are provided with openable windows, together with fixed sash vents and wind-powered rotary exhaust vents as previously discussed. Heating is important to make the bathrooms more comfortable for occupants, and to enhance the ventilation system by means of a stack effect between the bathroom space and the exhaust vents to the outside.

Shade and shelter outdoors [1.7% added cost

- Wide verandahs. To minimize the risks associated with solar radiation and the problem of skin cancer, the proposed house has above-average amounts of sheltering verandah roofing (both to the east and west). The verandah also provides shelter for outside activity when it is raining and enables the occupants to leave doors and windows open for ventilation during poor weather. The garage has roller doors at each end next to paved terraces, to make it possible to open one or both doors and include the garage as sheltered semi-outdoor space.
- Tree. A mature shelter tree has been retained at the added cost of a low retaining wall to protect the root system.

Materials and products [2.7% added cost]

- Plywood flooring. Plywood flooring has been specified on the first floor instead of cheaper wood-product sheet materials for reasons of health and durability. Composite particle board materials, when used in large areas, off-gas with formaldehyde and other toxins. As well, HNZC is against the use of these cheaper materials because they delaminate and degrade if they get wet.
- Plywood joinery (carcases and shelves).   Ply is specified rather than the cheaper industry standard of medium density fibre-boards because the mdf products will delaminate, are less resistant to physical damage, and more difficult to maintain and repair. This choice covers kitchen, bathroom and laundry cabinets and bedroom wardrobes and shelves. [+ 0.4% added cost]
- Timber trim. Timber is specified rather than medium-density fibreboard for skirtings, cills and architraves (see previous item for the reason).
- Stainless steel bench tops in kitchen. Stainless steel is specified instead of laminates because of its robustness and long life, and more assured hygiene.

Space and size [8% added cost]

- Indoor areas and dimensions. The house is designed to the least dimensions and area per person that will adequately serve the range of intended functions, but in the smallest spaces in the house (e.g. the shower, the toilet) and tightest dimensions (e.g. between a bed and a wardrobe), this "most economical" space allocation has to be *more* than the minima found in standard speculative housing and recommended in the ergonomics and space standards literature. An estimated 12m2 or 6% of additional floor area of the house is attributable to the special needs of an extended family house. Among the reasons for this are: the larger body size of many Pacific Island and Maori people compared with their European counterparts; a more diverse range of functions resulting from a larger household and its multi-generational makeup; a cultural tendency to welcome and accommodate visiting family members for extended periods; and the presence in most large households of at least some elderly members with a range of mobility and other physical difficulties.
- Gross building area. The proposed house has an area of approximately 196m2 enclosed habitable space plus 29m2 semi-habitable space in the garage and about 40m2 of external paved space, some of it sheltered. It is perhaps stating the obvious, but the large size (and the higher than average total cost of this social

housing unit) is an inevitable result of designing for a large household population. In effect, the house is equivalent to between one and a half and two standard houses of modest proportions housing the same number of people in total. But by no stretch of the imagination could the house size be called excessive or luxurious in the New Zealand context and for its intended occupancy. The average area per person in the proposed house is 17.8m2, not including the garage. By way of comparison, my household considers itself pushed for space with 30m2 per person, and many middle class households in the country occupy houses well in excess of this figure. If the garage is included in these calculations the average area per permanent occupant is 20.5m2, but a more meaningful way to factor the garage into area per person calculations is to count the number of sleep-over visitors that the house could accommodate in addition to the permanent residents. Adopting marae-style sleeping arrangements in the garage and main living room, this house could accommodate an additional 6 to 9 people on a short-term basis.

- Large doors. Doors that give access to the main reception and living areas of the house, and downstairs facilities, are wider and higher than standard. This is to provide generally for large-bodied people, and for access by people with disabilities. More specifically, wide doors are needed to enable the dignified handling of a coffin. Wide doors between the kitchen/dining area and the outside terrace area are designed to enable the table to be taken outside.
- Large outdoor paved areas. Verandahs and paved outside terrace areas are larger than usual, to serve populations with a cultural need for outdoor living and gatherings of visitors. The paved driveway is also longer than usual, with a turning area and added parking space, because the house is located on a back section.

Facilities [5.2% added cost]

- Toilets. The large household and occasional influx of visitors places added demands on the facilities, especially the toilets. The proposed house has three toilets, with one being accessible from outside the house via the laundry.
- Outside play. A larger-than-usual area for play is provided, secured by fencing and gates.
- Outside sink. An additional sink is located outside the house for such activities as washing fish.
- Computer workstation area. Space is set aside, away from the main habitable areas, for a computer station, with room for two kids to sit side by side at the computer.

The cost of meeting the requirements for health and cultural appropriateness

An quantity surveyor estimated the *added* capital cost of providing the added performance capability as outlined above. When compared with a conventional or modal house of the kind provided by speculative design-build companies, the extended family house with the required qualities was found to add between one quarter and one third to the cost of the modal house. Another way to express this is to say that the added qualities and facilities amounted to 20 - 25% of the total construction cost for the house.

On the other hand, the cost of *not* providing housing to an appropriate standard may be higher than the added capital cost for houses. These (so far) hidden or ignored costs could be measured in terms of the added burden on health services, and the social cost of people, especially children, not meeting their potential. An immediate benefit of improved quality of housing is also to be found in reduced operating costs.

Policy implications

One conclusion we can draw from the events of the 1990s is that the private sector cannot be looked to for the provision of social housing. It seems, for the time being at least, that Governments build and manage social housing – or not. This means that as a society we have to somehow decide what is needed – what are the reasonable requirements of low income households - and how can we agree on the quantity and qualities of what we build?

Quantity and quality are intimately related principles – so much so that in some systems of logical argumentation they are discussed simultaneously. In Western philosophy since Aristotle an embedded assumption has been that a determination of essential quantity is necessarily a determination of essential quality. In the context of housing, where an appropriate definition of quality is *that which meets requirements, no more and no less*, size and space are concerns, the number of toilets matter, the number of bed-spaces matter, and various other quantitative things matter in defining the essential quality of the house. In these matters, there is an *implicit* argument for quality that comes with essential elements of quantity. In other words, once the appropriate quantity is found, the appropriate quality is necessarily found as well.

However, in other aspects of the house-tenant-community-society system, the argument for quality needs to be made *explicit.* For example, an explicit argument can and should be made about how easy a house is to furnish in a variety of ways to suit different needs. Or, to give other examples, we need explicit measures of how well a house enables the family to eat together if they want to, or about the meanings and rituals attached to the house entry, or about the extent to which the ventilation occurs without occupant interventions. Numbers and quantities play a part in defining qualitative requirements, but the focus should be on the performance of the system, and the "fit" between the house, its occupants, and their activities. This is particularly important in designing or deciding on those parts of the system, logically speaking, in which the relationships between things are *contingent* rather than *necessary.* Thus, whether a house ends up being damp or dry is contingent on various factors including the behaviours of the occupants. Paradoxically, the performance of a house is driven by how it is used, but (in large households at least) its users are in effect powerless to extract the necessary performance. The resolution of this paradox is

What are the implications for government policy and for the design and provision of social housing? The author offers the following four observations.

1. *We lack a widely accepted (but evolving) definition of the qualitative requirements of social housing.*
2. *Dwellings that are built to the minimum requirements of the Building Code do not necessarily meet the diverse and reasonable requirements of extended family households (and possibly other household types).*
3. *Innovative design and delivery solutions are needed because traditional designs and standard practices are not serving us well enough*
4. *As indicators of progress and overall performance in the provision of social housing, the number of unit completions and capital cost per unit, are blunt instruments.*

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Deciding on the qualitative aspects of our social housing is the tricky part. It's not that quality cannot be measured, though certainly it is a more complex question than counting the number of housing units completed in a year. I think it is more likely that quality in housing is not yet a political irritant, and that therefore it is yet to be seen a serious question for policy analysts.

I have been trying to understand why it is (apparently) that people were healthier in and more satisfied with a state house built in, say, 1950 or 1970, than they are now with houses that are insulated and conveniently heated, with more more devices and products, even more space. Why weren't cold and damp issues in 1950? Are we all soft when compared with parents and grandparents? For generations our social housing has met the needs of most households quite well, but in the past 30 years or so years the match between house and householders has eroded. What has changed?

In the first place, the households themselves have changed, shifting away from the nuclear family model towards far greater diversity in numbers and relationships of people within households. Less obviously, how people live their lives has also changed and become more diverse – work patterns, hygiene norms, food, clothing, recreation, community activity. Building methods and interiors have changed – aluminium windows, new forms of cladding, heating, products, appliances. The social and political context, physical infrastructure, even the climate, have slowly shifted as well. In combination, these things are now frequently out of sync, even though there may be apparent progress and improvements in any one of the elements. For example, electrical or gas heating products have supplanted the open fireplace for heating. They are more efficient, cheaper, and a lot less trouble. Consider windows. Aluminium window joinery has overtaken timber joinery because it is less expensive, it is more accurate, does not rot, twist or shrink, is more reliably weathertight, and is much less draughty. In combination, new more efficient forms of heating, better insulation and more airtight buildings would seem to be a perfect solution to the problem of cold. However, rogue problems are just around the corner. The air temperature inside may be just right, but people still feel cold because of radiant heat losses from the body to the single glazing and cold aluminium surfaces of the windows, and to the cold floor. The clothing being worn nowadays tends to be synthetic and a lot less of an insulant. The house is closed up during the day for security while everybody is away at work or school, and closed up at night to keep warm. Moisture builds up in the interior because there is much less ventilation occurring through the building envelope.

Houses, when inhabited, become homes